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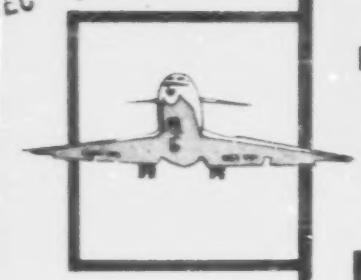

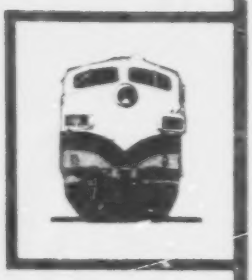

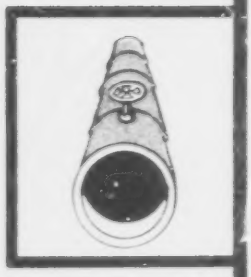

NATIONAL TRANSPORTATION SAFETY BOARD

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WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

NEW YORK CITY TRANSIT AUTHORITY SUBWAY SYSTEM FIRES

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16. Abstract

This report details the results of a special investigation into fires on the New York City Transit Authority (NYCTA). Because of its continuing concern about the large number of fires occurring on the NYCTA subway system, the Safety Board undertook a special investigation on December 10, 1984, to examine the issue of fire safety as it relates to track and structures, electrical equipment, car equipment, train operations, emergency response activities, and data collection. The investigation identified the following fire safety issues: fire incident data collection, trash in tunnels, emergency response and equipment, car equipment fires, training, and safety oversight. The report discusses these issues, discusses past Safety Board recommendations concerning these issues made to the NYCTA, the New York Fire Department, and the New York State Public Transportation Safety Board (NYSPTSB), and makes more recommendations to the NYSPTSB.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C..

SPECIAL INVESTIGATION REPORT

Adopted: October 23, 1985

NEW YORK CITY TRANSIT AUTHORITY SUBWAY SYSTEM FIRES

INTRODUCTION

Fire safety is critical in a rail rapid transit system because fire and smoke in the physical and operating environment of such a system can be extremely hazardous and difficult to control, particularly in the confined space of an underground subway tunnel. Consequently, the National Transportation Safety Board has been concerned with these issues since its inception in 1967.

On July 28 and 29, 1980, the Safety Board held a public hearing as part of a nationwide safety effectiveness evaluation of rail rapid transit safety. 1/ The Safety Board examined fire safety issues involving transit car design; exiting from cars in an emergency; tunnel ventilation in an emergency; evacuation from tunnels; emergency procedures, including employee training and drilling; emergency communications; emergency equipment; and local/State/Federal safety oversight of rail rapid transit properties.

In that same year the Safety Board undertook a special investigation of fire problems on the New York City Transit Authority (NYCTA). 2/ The Board examined eight car equipment fires spanning a 13-month period that resulted in 53 injuries and property damage to subway cars in excess of $500,000. As a result of its investigation, the Board issued Safety Recommendations R-81-103 through -115 on December 30, 1981, to the NYCTA concerning training of personnel, inspection and maintenance of car equipment, emergency equipment, testing of emergency equipment, emergency procedures, and the NYCTA management information system. (See appendix A.)

Fires have continued to be a major problem in the NYCTA subway system, and the Safety Board has continued to monitor the fire incidents since its special investigation in 1980-1981. For example, in the first 11 months of 1984, there were 4,958 confirmed fires, of which 2,449 involved track and surrounding structures and 1,957 involved car equipment. The New York Fire Department (NYFD) responded to 946 of these fires.

Because of its continuing concern about the large number of fires occurring on the NYCTA subway system, the Safety Board undertook a special investigation on December 10, 1984, to examine the issue of fire safety as it relates to track and structures, electrical equipment, car equipment, train operations, emergency response

1/ Safety Effectiveness Evaluation Report--"Rail Rapid Transit Safety" (NTSB-SEE-81-1).
2/ Special Investigation Report--"Eight Subway Fires on New York City Transit Authority with Evacuation of Passengers" (NTSB-SIR-81-5).

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activities, and data collection. (See appendix B.) As part of this special investigation, the Board investigated six accidents involving fires that occurred before the special investigation and one that occurred during the special investigation. (See appendix C.) The special investigation identified the following fire safety issues:

- Fire Incident Data Collection--The NYCTA has two data collection systems that are fragmented, are inaccurate, and are inadequate for use in making safety assessments.

- Trash in Tunnels--Most of the fires result from trash that has been allowed to accumulate between the tracks and around the third rail in subway tunnels. Trash pickup and removal has been inadequate. Open containers of flammable materials have been allowed to be stored in subway tunnels.

- Emergency Response and Equipment--The NYCTA often has delayed reporting of fires to the NYFD. Firefighters do not understand the proper method to remove third-rail power in an emergency. Some fire extinguishers in subway tunnels are empty and others are missing from their designated locations. Subway cars do not have fire extinguishers. There often is poor communication between NYCTA and NYFD personnel. Firefighters do not have maps of the tunnel and track locations. Some emergency exits are unusable, and the NYCTA and NYFD do not know the conditions of all exits on a current basis.

- Car Equipment Fires--Many fires begin in the motor control groups on subway cars. The NYCTA has inadequate maintenance and inspection practices for its cars. NYCTA practices concerning the procurement, inspection, and distribution of parts contribute to frequent failure/fire incidents.

- Training--A sufficient number of employees have not been trained in car maintenance and inspection to eliminate car maintenance deficiencies.

- Safety Oversight--Self-regulation by the NYCTA has not brought the changes necessary to improve fire safety.

FIRE SAFETY ISSUES

Fire Incident Data Collection

Fire safety is critical in a rail rapid transit system such as the NYCTA because fire and smoke in the physical and operating environment of such a system can be extremely hazardous and difficult to control, particularly in the confined space of an underground subway tunnel. During this special investigation, the Safety Board reviewed fire incident data of subway fires on the NYCTA from January through November 1984 and documented the scope of these fires for two major areas of concern--track and structures and car equipment.

The Safety Board special investigation in 1980-1981 identified the inability of NYCTA management to obtain useful data from its management information system about failures and incidents that might affect the safety of passengers. Following that

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special investigation, the Board issued Safety Recommendation R-81-115 on December 30, 1981, recommending that the NYCTA:

> Revise the NYCTA automated management information system to provide sufficient detailed information to permit analysis of the incidence and causes of failures or malfunctions of equipment which may affect the safety of passengers.

The Board classified the recommendation as "Closed--Acceptable Action" when the NYCTA advised that it had installed a new system. However, the current special investigation revealed that the management and distribution of fire safety information for the NYCTA now rests with three different departments--track and structures, car equipment, and system safety. The Track and Structures Department prepares a number of data sheets on the total confirmed NYCTA fires 3/ by month and general type, i.e., car equipment fires, track and structures fires, and station fires. The Car Equipment Department also provides data on car-related fires. The System Safety Department reviews the data from the two other departments and attempts to resolve discrepancies between the two car data bases. The Board's investigation found that the figures reported by the departments regarding car equipment fires did not coincide and, therefore, could not be relied on as an accurate representation of the NYCTA fire problem.

Track and Structures Fires.--The NYCTA reported that there were 2,449 confirmed track and structures fires from January through November 1984; 1,487 of the fires occurred in the first 7 months of 1984. In comparison, there were 1,773 confirmed track and structures fires in the first 7 months of 1985, according to the NYCTA. However, the NYCTA believes that the increase is due to better recordkeeping since the Safety Board's special investigation began in December 1984. The NYCTA's fire statistics for the months were reported to NYCTA senior management by the chief engineer of the Track and Structures Department. (See table 1.) The NYCTA categorized track and structures fires as trash fires, which accounted on a monthly average for 35 to 40 percent of the fires; fires of unknown origin, which accounted for approximately 35 percent of the fires; burning/scorched ties or burning/scorched slatting, 4/ which accounted for from 5 to 10 percent of the fires; and bad order train sparks, cables, steel dust, lubrication, third-rail insulation material, and sparks, which accounted for the remaining fires. Table 2 shows the number of confirmed track and structures fires on the NYCTA for the major fire categories of refuse, burned/scorched ties, and burned/scorched slatting.

Approximately 850 (35 percent) of the 2,449 confirmed track and structures fires were of unknown origin. In these cases smoke or fire was detected by someone on the NYCTA and reported to the Track and Structures Department control office, which maintains a daily 24-hour fire record, but the origin of the fire or smoke was not further documented or verified. Safety Board investigators were told that the reports were not verified either because the source or location of the smoke could not be determined or because the Track and Structures Department did not respond.

The fire data did not reveal any unusual or consistent pattern of third-rail feeder or cable fires or third-rail insulator fires. An average of four to five such fires per

3/ A "confirmed" fire is any reported fire or smoke incident, the existence of which is confirmed by either an NYCTA employee or the NYFD. Source: NYCTA System Safety Department Report, November 8, 1984.

4/ A wooden board secured to the ties alongside the rails to provide a walkway.

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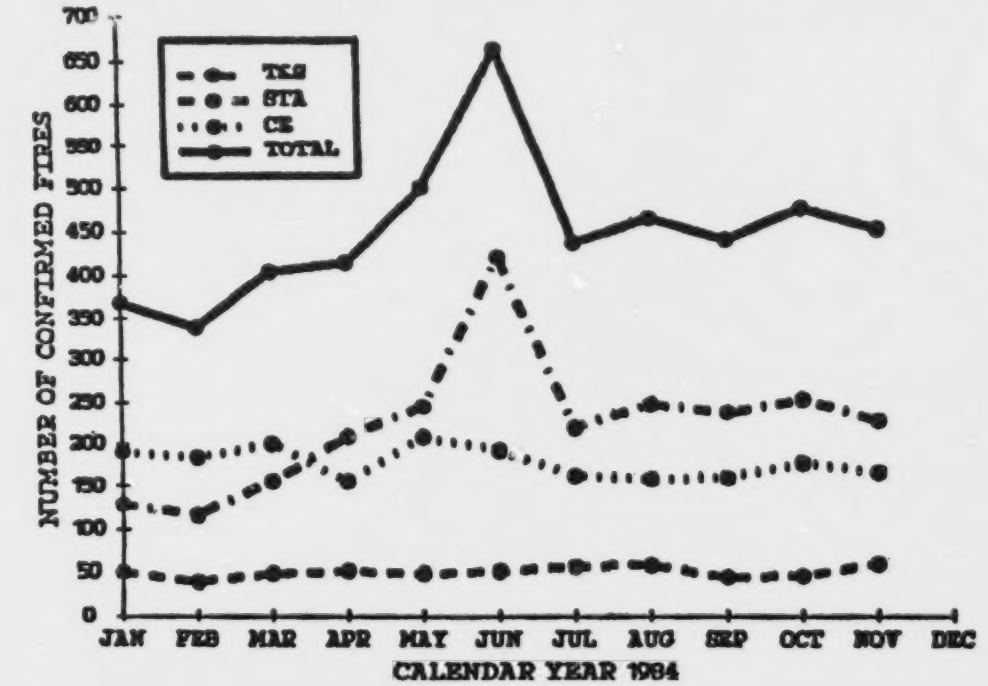
Table 1.—Confirmed track and structures fires on the NYCTA system, January through November 1984.



MONTH	CONFIRMED FIRES T&S	STA.	CE
JAN	128	50	190
FEB	116	39	184
MARCH	155	47	199
APRIL	207	51	158
MAY	244	48	208
JUNE	419	53	192
JULY	218	56	163
AUG	247	58	159
SEPT	236	45	160
OCT	253	46	177
NOV	226	59	167
TOTALS	2,449	552	1,957

T&S = Track and Structures Fires

STA = Station Fires

CE = Car Equipment Fires

Source: New York City Transit Authority

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Table 2.—Confirmed track and structures fires on the NYCTA system by category and NYCTA division, January through November 1984.

Months	IRT			BMT			IND			Totals
	Refuse	Ties	Slatting	Refuse	Ties	Slatting	Refuse	Ties	Slatting	
Jan	22	3	0	22	4	2	16	0	0	69
Feb	34	3	1	17	4	1	10	0	0	70
Mar	45	10	3	25	4	1	16	3	1	108
Apr	37	12	4	27	22	7	14	2	0	125
May	35	3	9	40	13	6	12	2	2	122
Jun	41	24	7	35	29	17	15	6	0	174
Jul	33	10	6	25	11	7	10	3	0	105
Aug	37	12	9	28	29	7	14	1	0	137
Sept	39	13	7	27	23	9	13	3	0	134
Oct	60	17	4	29	11	5	29	1	0	156
Nov	46	14	4	26	11	3	17	0	0	121
TOTALS	429	121	54	301	161	65	166	21	3	1,321

IRT = 46%
BMT = 40%
IND = 14%

month involving the third rail were reported. These occurrences were random throughout the system. The data did not indicate that any of the three NYCTA divisions had a higher number of fires for a particular category, with the exception of refuse fires. Refuse fires were higher on the IRT division than on the BMT or IND divisions.

The track and structures fire data are incomplete, however. Although the confirmed fires were reported to the Track and Structures Department control office, there was no consistent system that provided followup on a description of the damage. Moreover, although 35 percent of the fires were of unknown origin and reported to senior management as confirmed fires, Safety Board investigators could not determine why some of the fires were categorized as a confirmed fire for track and structures. The reports reviewed by the Board indicated that refuse fires in almost all cases resulted in no physical damage to track or structures. The track and structures personnel were confident that the data reflected all serious track and structures fire incidents.

The Safety Board believes that the NYCTA should effect improvements in the track and structures fire data reporting system to differentiate between fire reports and actual fires. The NYCTA should develop a more precise definition of a confirmed fire and should categorize its track and structures fire reports to reflect accurately the hazards posed to the traveling public. The current system on which management is relying is not providing adequate assistance to NYCTA senior management in the identification of serious track and structures fire hazards.

The NYCTA has not fashioned a link between the reported track and structures fire data and its system safety assessment efforts. The NYCTA should develop a system that periodically analyzes the track and structures fire data. This would necessitate improvements in the reporting system, documentation of each incident, and cause determination. The track and structures fire data should be assessed by the NYCTA System Safety Department, and this department should recommend courses of action to senior management for safety improvement. The track and structures fire data as currently reported are not a reliable indicator of track and structures fire safety conditions on the NYCTA; therefore, the data cannot be used to do such analyses.

Car Equipment Fires.--Car equipment fires pose one of the greatest hazards within the close confines of a subway system. NYCTA car equipment fire data were more accurate than the track and structures fire data. The car equipment fire data did not reflect an "unknown" fire category as was found in the track and structures data. The NYCTA reported that there were 1,957 confirmed car equipment fires from January through November 1984; 1,293 of the fires occurred in the first 7 months of 1984. In comparison, there were 1,899 confirmed car equipment fires in the first 7 months of 1985, according to the NYCTA. Like the increase in track and structures fires, the NYCTA believes that the increase in car equipment fires is due to better recordkeeping. In addition, the NYCTA stated that the severity of the fires in 1985 has been less and that no cars have been destroyed or persons evacuated because of motor control group fires. Three equipment systems stand out as posing potential risks for fire--the traction motors, which accounted for approximately 50 percent of the confirmed car equipment fires; the trucks, which accounted for 10 percent of the fires; and the motor control groups, which accounted for about 10 percent of the fires; about 30 percent were from a variety of other electrically related sources.

The NYCTA has had a number of serious motor control group fires, such as one that occurred at the Borough Hall Station on October 11, 1984. (See appendix C.) Although traction motor and truck fires issue smoke and are thus dangerous, the motor control

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group fires historically have been the fires that have produced dangerous situations for passengers. Fortunately, no deaths have resulted from motor control group fires. However, the NYCTA System Safety Department, in an internal report of the October 11, 1984, fire, termed the potential hazard severity of a motor control group fire as "catastrophic," an assessment the Safety Board has made on a number of occasions.

Two NYCTA data systems document and report motor control group and other equipment fires. One reporting system is prepared from car equipment fire report cards and entered into the car equipment information system. This report is submitted to NYCTA senior management for inclusion in the NYCTA system fire statistics. Another report of car fires is prepared by the management systems group within the Car Equipment Department. This report is provided only to the System Safety Department. From January through November 1984, there were from 202 to 283 motor control group fires, a difference of 29 percent, depending on which data system was queried. (See table 3.)

Table 3.--Motor control group fires reported in 1984.

Month	Reported to senior management	Reported to System Safety Department
January	17	26
February	10	19
March	26	15
April	20	15
May	22	15
June	31	30
July	17	29
August	15	46
September	9	27
October	14	31
November	21	30
Total	202	283

The System Safety Department reviewed the data for the motor control group fires for a 3-year period, from July 1, 1981, to June 30, 1984. This review resulted in the following findings:

- 721 motor control group fires occurred during the 3-year study period.
- The number of motor control group fires increased in each of the 3 years.
- 67 percent of the motor control group fires occurred on IRT division cars, 22 percent on BMT division cars, and 11 percent on IND division cars.
- The IRT division No. 1 route experienced the highest number of motor control group fires.
- Of the cars that experienced motor control group fires, 69 percent were equipped with the Westinghouse Electric Company controller and 31 percent were equipped with the General Electric Company controller.

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- The car types that experienced the most motor control group fires incidents were the R-10-, R-14-, and R-15-type cars.

- 92 cars that experienced motor control group fires during the study period had previous motor control group fires.

The NYCTA analysis concluded that although motor control group fires occur throughout the car fleet, the older IRT division cars appeared to be more susceptible to such fires. The NYCTA could not ascertain whether this was due to the higher age of the IRT division fleet, to the operating characteristics of the route to which those cars are assigned, or to maintenance practices.

A review by Safety Board investigators of the motor control group fire data for the first 11 months of 1984 indicated that the upward trend in motor control group fires continued and that the majority of motor control group fires still were occurring on cars operating on the IRT division, and that motor control groups with Westinghouse controllers still had more fire incidents than motor control groups with General Electric controllers.

The Safety Board believes that the difference in the two data bases for reporting motor control group fires should be resolved. The car equipment fire data should be reported directly to the System Safety Department, which should undertake periodic safety assessments of these data. At present, the System Safety Department undertakes an assessment only at the specific direction of NYCTA senior management. The System Safety Department also should forward recommendations periodically to NYCTA management to reduce the risks to the traveling public caused by motor control group fires. The System Safety Department also should institute quality control procedures to verify the accuracy of the data. Data analysis and recommendations for safety improvements to minimize car equipment fires should be undertaken as the data are collected and reviewed each month by the System Safety Department. The System Safety Department should audit annually all of the reporting systems and the data entries to ensure that proper data are reported from each of the systems.

NYFD Fire Response Data.--The NYFD responded to approximately 946 of the confirmed track and structures and car equipment fires on the NYCTA from January through November 1984. The NYFD reported these incidents as one-line entries on a "Report—Transportation Fire, Non-Structural Fire Emergency." A majority of the NYFD responses in October 1984 that were reviewed by the Safety Board involved refuse and car equipment fires that were extinguished by hand-held extinguishers. The NYFD provided the Safety Board with reports of 37 of the 91 fires listed during the month of October 1984. Of these 37 fires, 10 were refuse fires, 5 were track and structures fires, 15 were car equipment and related fires, and 7 were station fires. Of these 37 fires, 5 involved injuries to emergency response personnel and/or passengers. The major cause of injuries was smoke inhalation. The NYFD explained that most of the fires were given only a one-line entry because the fires were characterized as minor. The NYFD said that it planned to improve its data-reporting system to include more information on NYCTA fires.

Trash in Tunnels

The special investigation found that trash fires accounted for 50 to 55 percent of the fires reported each month on the NYCTA system. Trash has been allowed to accumulate in tunnels beside and between the tracks and under and next to the third rail.

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Even after NYCTA employees have collected and bagged the trash for eventual disposal, the bags often have been left near the track for several days awaiting collection. As many as 200 bags, some containing newspapers a month old, were found stored in the tunnels. Much of the trash was newspapers and fast-food wrappers and containers traced to products sold to the public by the concessionaires in the station areas of the subway system. The materials found could be ignited easily by arcing from the interaction of the power collector shoes on the trains and the electrified third rail on the track.

In a survey of riders of the NYCTA subway system conducted by Louis Harris & Associates, Inc., in 1978, 50 percent of the respondents identified filthy conditions as one of the top problems with the subway system. 5/ According to a report issued by the New York City Mayor's Office in 1983, "decades of abuse and neglect by both subway riders and those responsible for maintaining the subways has led to a decline in the cleanliness and appearance of the system." 6/ A report by New York City Partnership, Inc., in 1983, states "although the retail concession activities are considered to contribute to a more attractive station ambiance, they are a major source of litter and refuse." 7/ The report made several recommendations to the NYCTA regarding an antilitter campaign and an improved litter containment program.

As of December 1984, the NYCTA had 187 employees assigned to track cleaning. The NYCTA cleaned busy stations once each week and cleaned less busy stations less frequently. The NYCTA was aware of the problem of trash in the system. In a 1984 letter to the NYCTA's Advisory Council, the NYCTA president outlined the problem of trash removal and stated that the NYCTA was attempting to improve its efforts for trash removal from the subway system.

During its special investigation, the Safety Board issued Safety Recommendation R-85-25 on March 28, 1985, recommending that the NYCTA:

> Immediately conduct a one-time cleanup of the subway tunnels of all combustible materials and debris, augmenting NYCTA resources if necessary, and thereafter schedule a systematic debris collection program and require that collected trash be removed quickly.

The NYCTA responded to this recommendation on May 16, 1985, and advised that,

> The Track and Structures Department began a one-time cleanup of the entire rapid transit system prior to the Safety Board's field investigation activities in December 1984. The majority of this cleanup effort is being handled by dedicated track cleaning personnel, with only a minimum amount of support from other maintenance people. Given the importance of other critical day-to-day maintenance activities related to the inspection and repair of track, signal, and power distribution systems, we strongly believe that cleanup activities should be limited to the cleaning personnel so that adequate levels of safety are maintained.

5/ "A Survey of Manhattan-bound New Yorkers," Louis Harris & Associates, Inc., conducted for New York State Department of Transportation, April 1978.
6/ Mayor's Office, New York City Transit Report, 3/23/83 (section II, page 1).
7/ New York City Partnership, Inc., "New York City Transit Authority Task Force, Station Cleaning," August 2, 1983.

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> The initial phase of this effort, which involves cleaning out all the wide areas between tracks and the abandoned rooms, as well as neatly stacking and inventorying all usable materials, is approximately 75% completed. The next phase will involve cleaning out all of the concrete track troughs where significant amount of debris collect. We expect to complete both phases by July 1985 with no disruptions to normal maintenance activities. Once the cleanup is completed we will begin a normal cycle of track cleaning and scrap pickup.

Inspections conducted each week since December 1984 on the subway system by investigators from the New York State Public Transportation Safety Board have noted some improvement in the removal of trash from the system, and the July 1985 target date for complete cleanup was achieved. However, since it took 7 months to complete the one-time cleanup of the transit system, which the Safety Board believes was an unduly protracted timeframe for cleaning the subway tunnels, the Board consequently questions the capability of the 187 employees assigned to track cleaning to maintain the system in a clean condition. Continuing measures will have to be taken to reduce litter, such as increasing the number of cleaning personnel, increasing the frequency of cleaning operations, better policing of the discard of litter in the system, and eliminating the sources of litter. Because of the role of litter in subway fires, the Board urges the NYCTA to maintain a litter-free subway system.

In addition to the fire safety problem created by trash, the Safety Board discovered that the NYCTA stores flammable materials in subway tunnels. Investigators found the lids of signal department lockers open and containing open cans of paint and/or other flammable materials. Many of these lockers were close to the third rail, and in some locations large quantities of trash were stored close to the lockers.

During its special investigation, the Safety Board issued Safety Recommendation R-85-26 on March 28, 1985, recommending that the NYCTA:

> Immediately remove all flammable materials from subway tunnels, and prohibit the storing of flammable materials in all tunnels.

The NYCTA responded that,

> both the Track and Structures and Electrical Departments use numerous materials, some of which are flammable, that are critical to the daily operation and maintenance of track and signal equipment.
>
> As such, it is essential that these materials be kept near where they will be used. Therefore, it would be impractical to prohibit the storage of any or all flammable material in the subway.

The NYCTA acknowledged, however, the importance of good housekeeping practices to ensure the safe storage of flammable materials. In that regard, the NYCTA stated that it had taken the following actions relative to the storage of flammable materials:

- All paint lockers have been examined and secured. Those located near where debris bags are stored were relocated.

- Positive compliance directives have been issued to signal maintenance personnel outlining the procedure regarding maintenance and use of oil storage boxes. Supervisory employees were directed to ensure compliance.

- All existing signal equipment oil storage boxes have been inspected. Present plans provide for painting the boxes yellow and labeling them as containing flammable material. Twenty-five newly approved steel oil boxes have been ordered, and 10 Halogen fire extinguishers have been ordered for test installation in the boxes.

- Kerosene for hand lanterns is stored in specified cabinets, and grease for rail lubricators is stored in drums in locked pumprooms.

The Safety Board notes the action taken by the NYCTA to improve the safe storage of flammable materials in the subway system. However, the Board believes that the storage of flammable materials in the subway system, regardless of the precautionary measures taken to store these materials, poses an unnecessary risk to the public and operating employees. In the event of a subway fire, the presence of flammable materials increases the potential hazard of a fire as a further source of combustion. The Board believes that these materials can be transported easily when they are needed to and from the area where they are needed for the operation and maintenance of track and signal equipment.

Emergency Response and Equipment

Fire Extinguishers.--According to NYCTA rules, fire extinguishers are required to be located at all blue light 8/ stations in tunnels. Safety Board investigators found numerous consecutive blue light stations that did not have the required fire extinguishers. Several locations where extinguishers were missing were on the IRT division line between Grand Central Station and Astor Place and in the Union Square Station, on the Broadway-7th Avenue Line between 86th and 96th Streets, and at De Kalb Avenue on the BMT division line. This circumstance can delay effective action to control a fire, as it did in an accident at the 34th Street Station on December 13, 1984, in which the road car inspector and the train operator went to blue light stations to obtain extinguishers and found that there were no extinguishers at those locations. (See appendix C.)

During its special investigation, the Safety Board issued Safety Recommendation R-85-27 on March 28, 1985, recommending that the NYCTA:

> Provide fire extinguishers at all designated locations in the subway system, and establish a program to inspect regularly and replace promptly any missing or empty extinguishers.

The NYCTA responded that,

> After being made aware by the Safety Board of the magnitude of the fire extinguisher problem a special program to identify and replace missing

8/ A subway location at which an emergency telephone, a third-rail power cut-out switch, and a fire extinguisher are located. These locations are approximately 600 feet apart throughout the subway system.

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> and/or discharged fire extinguishers along the right-of-way was implemented. This program began on December 17, 1984 and was completed on January 15, 1985. It included visual inspections by supervisory personnel who rode the front end of trains and a walking inspection of the entire system by hourly personnel. Replacement of all missing and/or discharged extinguishers was completed on January 15. Personnel from the Structure Division of the Track and Structures Department inspect the fire extinguishers regularly and the entire system is inspected each month.
>
> As a result of our recent efforts, we have learned that our extinguishers along the right-of-way are subjected to a high degree of vandalism and theft. In some months, we have had to replace over 600 out of 2,200 fire extinguishers due to vandalism and theft. We are now working with the Transit Authority Police (TAP) in identifying areas where the problem is acute so that appropriate corrective measures can be instituted.

Based on the NYCTA's corrective efforts and the NYCTA's assurance that it will inspect the entire system each month for missing or inoperable extinguishers, the Safety Board believes that effective action has been taken to meet the intent of Safety Recommendation R-85-27.

Prior to 1979 each subway car on the NYCTA system had been equipped with a fire extinguisher. However, because of a high number of incidents of vandalism and theft, NYCTA management decided to discontinue equipping subway cars with fire extinguishers. Therefore, since 1979 the NYCTA has not had fire extinguishers onboard its trains. In an incident at the Rockaway Boulevard Station on April 17, 1984, the conductor was not able to communicate with the train operator to stop the train en route where he could obtain a fire extinguisher. He was not able to obtain a fire extinguisher until he arrived at the station and requested one from the station porter. After he obtained the fire extinguisher and returned to the burning car, the fire and smoke were too intense for the employees to bring the fire under control. (See appendix C.)

In its 1980-1981 special investigation, the Safety Board, in reviewing emergency fire equipment, found that fire extinguishers were not onboard subway cars and that minor fires became major fires resulting in substantial damage to equipment because train operators and conductors did not have fire extinguishers readily available for use. In its 1981 special investigation report, the Safety Board made the following statement which the Board still believes is valid:

> Compounding the problem of lack of emergency training is the fact that NYCTA subway trains do not carry fire extinguishers. According to testimony of the International Association of Fire Chiefs at the Board's public hearing, a fire can rapidly escalate to an intensity of 600° to 800° within 6 minutes. Yet, in the critical early moments when a fire is first detected, before a flashover occurs, the only available firefighting equipment is outside the train up to 600 feet away on the tunnel wall. In the time it takes to leave the train, identify the problem, search for a fire extinguisher, and return, it may be too late to be effective. The problem of security for on-board fire extinguishers is certainly a serious one in view of NYCTA's past experience with vandalism and theft. In 1974 it cost $244,499 to replace and maintain fire extinguishers on board

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trains. But there are at least two positions in the train which provide a reasonable degree of security--the locked compartments manned by the motorman and conductor. Provision of fire extinguishers at these two positions when a subway train is made up or just prior to dispatch would provide the needed capability to control a fire before a major flashover endangers the lives of passengers.

On December 30, 1981, the Safety Board issued Safety Recommendation R-81-109 recommending that the NYCTA:

> Provide at least two fire extinguishers, one at each motorman and conductor position, in all subway trains.

The NYCTA's most recent response to this recommendation stated that,

> When this recommendation was first made in 1981 the NYCTA stated that, given its overall operating environment, it would be impractical to implement. This was due primarily to our previous experience with fire extinguishers in the subway cars in that they were stolen and frequently vandalized. In addition, we also believed that the only type that could be carried on the cars (2 1/2 pound dry-chemical) was too small to be effective.
>
> The most serious fires that we experience on our rapid transit cars are those associated with the propulsion control equipment located underneath the floor. These fires are generally the result of extremely high over-temperature conditions involving high levels of electric current. Once such a fire starts, the only effective means of extinguishing it is the direct application of large quantities of water to sufficiently lower the temperature. The use of any type of fire extinguisher on these fires is impractical and unsafe.
>
> Existing procedures now require that whenever a car fire occurs the train is held in a station with its passengers discharged, and the New York Fire Department (NYFD) so notified. The train is held there until the NYFD responds so they can fight the fire within the confines of the station area. We believe that this procedure provides for a much higher level of safety for passengers and employees because it minimizes passenger exposure to fire and smoke conditions, and it leaves the fire fighting activities to those who are professionally trained to handle them.
>
> We still believe that implementation of this recommendation is impractical and would only serve to provide a false sense of safety to the public at considerable expense in terms of manpower and resources, with no appreciable improvement in the level of fire safety provided.

The Safety Board continues to disagree with the NYCTA that implementation of Safety Recommendation R-81-109 is impractical. Other transit systems have fire extinguishers on their trains in locked compartments hidden from passenger view. Clearly it is not a one-shot venture, but one requiring continuous attention. Nevertheless, the NYCTA should be well aware through experience of the added hazard attendant on the

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lack of fire extinguishers on its subway trains. For example, in the Rockaway Boulevard Station accident, had a fire extinguisher been onboard the train it is possible that the conductor could have controlled the fire during its initial phase and prevented the propagation of the fire, which resulted in the total loss of a subway car. (See appendix C.)

While the Safety Board has advocated that the NYFD always be notified immediately when any smoke or fire condition occurs in the subway system, any delay in attacking the source of the smoke or fire condition potentially increases the danger to passengers and operating employees and the possibility of damage to equipment. Critical time may be lost in these life-threatening situations awaiting the arrival of the NYFD. If fire extinguishers are readily available to the onscene personnel, immediate action can be taken to control the situation until the NYFD arrives.

The Safety Board is aware of the NYCTA's past experience with the theft and vandalism of fire extinguishers. The Board continues to believe that appropriate and easily implemented measures can be taken to ensure that fire extinguishers, even those larger than the 2 1/2-pound, dry-chemical extinguishers that the NYCTA believes are too small to be effective, are available in the manned compartments of the motorman and conductor.

The Safety Board firmly believes in the merit of Safety Recommendation R-81-109, and it cannot agree that providing fire extinguishers on subway cars would only serve to provide a false sense of safety to the public.

Standpipe System.--On December 13, 1984, the NYFD responded to a station platform fire in the station at 181st Street and Broadway. In order to initiate an attack on the fire, the battalion chief had to use 22 lengths of hose (approximately 1,100 feet) from the closest water source at street level. This action necessitated using considerable manpower to connect and bring the line to the fire, causing delay in applying water. No standpipe or other suitable water system was available in the station. As a matter of fact, any time the NYFD responds to a fire in the subway tunnels, it is necessary to bring hose lines from the street and in some cases through a station because there is no standpipe system in the tunnels and stations except in the tunnels under a river.

During its special investigation, the Safety Board issued Safety Recommendation R-85-33 on March 28, 1985, recommending that the NYCTA:.

> During the current construction work at the 181st Street Station, install a New York Fire Department-approved standpipe system with connections at the platform level.

The NYCTA responded that a number of meetings have been held between the NYCTA and the NYFD to discuss the need for including standpipe system installations in subway stations that are being modernized. As a result of these meetings, both agencies have agreed on the types of systems to be installed with each station and adjacent subway being handled separately according to its specific characteristics. With respect to the 181st Street Station, it has been decided that a single dry standpipe is necessary at that location.

Emergency Exits.--The location of and quick accessibility to emergency exits can be crucial during subway fires that require the evacuation of passengers. Emergency exits are inspected every 6 weeks by NYCTA personnel. This inspection covers locks, debris,

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signing, and lighting. Defects that can be repaired immediately are corrected, and work orders are issued for defects requiring more extensive work. The NYFD conducts a semiannual inspection of all emergency exits on the NYCTA system. However, the Safety Board's investigation discovered an emergency exit that could not be used because it had been damaged at the street level when struck by a vehicle several weeks earlier. The exit had been barricaded by NYCTA maintenance forces, but the NYCTA Command Center and the NYFD were unaware that it could not be used. At the track level entrance to this emergency exit there were no markings or a barricade to indicate that the exit could not be used. Other emergency exits were inspected and cardboard, paper, and burned paper were found indicating that people had been using the exits for shelter. Many of the steps and landing areas in the exits were dirty and wet, thus making them slippery and hazardous. At other exits the lights, many prone to vandalism, were out, making it difficult to walk without a portable light. NYFD personnel advised that emergency exit deficiencies were commonplace and that NYCTA corrective action was slow.

During its special investigation, the Safety Board issued Safety Recommendation R-85-31 on March 28, 1985, recommending that the NYCTA:

> Immediately develop procedures for notifying its command center and the New York Fire Department when an emergency exit is unusable and for returning the exit to service as soon as possible.

The NYCTA responded that it already has a standing operating procedure (SOP) regarding notification of appropriate NYCTA personnel whenever an emergency exit cannot be used due to maintenance or construction work. SOP #030-"Emergency Exits" requires NYCTA employees to provide appropriate signing at both the track and street levels and to notify the NYFD. The NYCTA stated that while new procedures are being developed and reviewed, its rapid transit operations, track and structures, and engineering and construction personnel have been directed to comply with the requirements.

When Safety Board investigators found the barricaded emergency exit, NYCTA employees accompanying the investigators were queried as to any instructions for notification regarding out-of-service emergency exits. No written procedure could be produced. When NYCTA Command Center personnel where questioned, they too could not produce any written procedure for notification. The NYCTA has advised the Board that it currently is revising its procedures regarding emergency exits to require that the NYFD be notified when exits are unusable and to ensure that the NYCTA Command Center is also notified at the same time.

The Safety Board also notes that the NYCTA requires work orders to be prepared and approved when extensive work is needed on emergency exits. The Board questions how emergency exits can deteriorate to a condition requiring extensive work if they are inspected by the NYCTA every 6 weeks. A blanket work order could be issued to the Track and Structures Department to make necessary repairs to emergency exits and return them to usable condition as soon as possible.

Communications.--The Safety Board's special investigation found that emergency communications between the NYCTA and the NYFD are hampered for several reasons: (1) the NYCTA reports to the NYFD of fire/smoke on the subway system often are not timely; (2) the terminology and expressions used by NYCTA and NYFD personnel in the performance of their duties are not mutually understood; (3) the NYFD has not fully understood the NYCTA procedures for shutting off power to the third rail; (4)

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communications among firefighters in subway tunnels are ineffective because of the limitations of the radios currently in use; (5) the NYFD is delayed in finding the exact location of some fires in the subway system because of a lack of maps of the system correlated to street locations; (6) NYCTA employees have not followed instructions given by NYFD firefighters during an emergency; and (7) NYCTA supervisors have not been available to aid NYFD firefighters in an emergency.

During this special investigation NYFD personnel expressed to Safety Board investigators concern about the timeliness of fire/smoke report notifications to the NYFD. Another concern was the communication problems between the NYFD alarm headquarters and the NYCTA Command Center. The NYFD personnel believed that many fire/smoke reports were not being relayed immediately to the appropriate NYFD alarm headquarters. Instead, NYCTA personnel responded to the reported fire/smoke areas to evaluate the situation themselves. This delay in notification to the NYFD could allow a fire to become larger and more difficult to control and extinguish.

NYCTA Command Center directive No. 28, states "if there is fire, heavy smoke or smoke is issuing from the group switch box, the train should not be moved, call the fire dept." However, in other paragraphs of the directive NYFD notification is only implied. The NYFD believes that it is not receiving reports of fire or smoke promptly, and the NYFD transit liaison officer on December 18, 1984, sent a letter to the NYCTA president requesting that the NYFD be called under the following conditions:

- All fires within the subway system;
- Any smoke condition within the subway system that cannot be immediately identified as to origin;
- Any smoke condition that would affect the safety of the public;
- In cases where NYCTA personnel extinguish a fire prior to the arrival of the fire department, this information should be immediately relayed to the fire dispatcher who will advise fire department units responding to the alarm. A transit employee should remain on the scene to explain the facts to the first arriving fire department units if practical.
- In addition, the fire department dispatcher should be notified of all fires within the subway system when extinguished by NYCTA personnel and to which the fire department did not respond (i.e., small trash fires in the tunnel with little or no smoke produced and reported to officials at a later time).

The differences between the NYCTA Command Center directive No. 28 and the NYFD needs outlined in the December 18, 1984, letter from the NYFD transit liaison officer indicate that agreement has yet to be reached between the NYFD and the NYCTA on precise criteria for NYFD notification and response. The Safety Board encourages both the NYFD and the NYCTA to jointly establish clear, mutually agreed-upon criteria for NYFD notification and involvement in transit fires.

In regard to communications problems involved misunderstandings caused by the use of different terminology, an incident occurred during the Safety Board's investigation that demonstrated how a communications problem can delay firefighting efforts. At

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11:04 a.m., on December 11, 1984, a fire was reported in the motor leads of a train at 96th Street and Broadway. The NYCTA reported the fire to the NYFD at 11:13 a.m. Firefighters arrived at the 96th Street entrance at 11:15 a.m. The initial report to the NYFD indicated only "north of 96th street, track 2 southbound." The fire chief said that when he entered the subway system at 96th Street he neither saw nor smelled any smoke. He then took the fire units to 103rd Street and 110th Street where smoke was seen. Trash was found burning on the southbound express track, and firefighters determined that no evacuation of the area was necessary. The fire chief requested that all power be turned off. Approximately 15 minutes later, the NYCTA advised that the power was off only on the northbound and southbound express tracks from 96th to 113th Street. In this area, the local tracks are on a different level than the express tracks. A NYCTA trainmaster responded to the location at 11:30 a.m. and assisted in identifying the exact location where the NYFD wanted power shut off. A review of tapes of the NYFD and NYCTA communications revealed that the delay in shutting off power to the third rail resulted from misunderstandings due to differences in terminology.

Safety Board investigators visited the NYFD training academy, reviewed the training material given to all firefighters during their 6-week training period, and viewed the subway car used to train firefighters in the various car components and hazards they could encounter when responding to a subway fire. The NYCTA does not participate in the training of the NYFD firefighters; however, the deputy chief of the training academy said that the NYCTA does supply electrical and mechanical car information to use in training firefighters.

The NYFD indicated more of a concern about its inability to communicate specifically to the NYCTA the exact location of a fire than about any unwillingness by the NYCTA to remove the power at the location or problems in dealing with a burning car. The NYFD stated that a marking system was needed in the subway system that would be easy for a firefighter to use to determine his location and to communicate to the NYCTA the precise location of a fire so that the NYCTA could quickly remove third-rail power from the area.

The December 11, 1984, fire incident at 96th Street and Broadway, when considered with the NYFD reports of similar occurrences, indicates a need for cross-training and familiarization of the NYFD dispatcher and NYCTA Command Center personnel with each other's operations. This training and familiarization needs to be accomplished to ensure mutual understanding of the terminology and geographical references between the two organizations, so that response information is relayed expeditiously and is accurately understood during emergency notifications and power shutdown coordination.

During its special investigation, the Safety Board issued Safety Recommendation R-85-28 on March 28, 1985, recommending that the NYCTA:

> Immediately train its command center personnel in the terminology used by the New York Fire Department to facilitate better communications during an emergency, and provide the fire department training materials for its use in familiarizing its personnel with essential terminology used in train operations.

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The NYCTA responded that,

> The Rapid Transit Operations Department is currently participating in an informal orientation training program with the NYFD. A major element of this program involves site visits by NYCTA Command Center personnel to the work locations of their counterparts at the NYFD, and vice versa. To date, sixteen NYFD dispatchers have visited the NYCTA Command Center and twelve NYCTA Command Center Superintendents have been to the Manhattan Fire Dispatcher's office.

In addition, NYCTA and NYFD training personnel have exchanged training materials such as course outlines, lesson plans, and classroom handouts. They also have established an interagency curriculum development group to update all training materials.

Another type of emergency communications problem involves firefighters' understanding how to operate the third-rail power shutoff lever at the blue light stations along the subway system. NYCTA training materials given to NYCTA employees explain that there is a 4-minute time limit in which the person who activates the third-rail power-off lever must contact the NYCTA Command Center trainmaster from the telephone at the blue light station. The material further explains that if the command center trainmaster is not contacted as to why the power was removed, the command center will assume that vandalism has occurred and will restore the power. The instructions explain also that if the telephone at the blue light station is not functioning, the third-rail power-off lever is to be operated two additional times after succeeding 4-minute intervals, which will indicate to the trainmaster that an employee has activated the lever, and power will not be restored until the area is checked by an NYCTA supervisor. The Safety Board found that the NYFD's understanding, however, was that once the third-rail power-off lever was pulled, the power would remain off; the NYFD did not know of the need to operate the handle a second and third time if the command center was not contacted after the initial cutoff.

NYFD personnel expressed concern about communications difficulties which occur when the NYFD is required to respond within the subway system. Specifically, the NYFD radios which operate on "line of sight" are incapable of transmitting or receiving effectively in the subsurface environment of the subway. NYFD personnel reported that effective radio communications can be implemented only by placing firefighters, equipped with portable radios, short distances apart and transmitting information in a relay manner. This method requires the use of a significant number of firefighter personnel who could be used in attacking a fire and/or assisting passengers to evacuate the danger area. Also, this relay method of communicating increases the time necessary to complete a transmission and significantly increases the potential for error. In the event of a major fire, two of the most critical elements in successfully attacking a fire are starting fire suppression as quickly as possible and having adequate manpower to make such an attack effective. A radio relay system such as the one that has to be used by the NYFD detracts from those vital elements and thus directly interferes with the success of the firefighting operations.

The NYFD has requested that the NYCTA install a "hardwire" communications system throughout the subway system which would have jacks at frequent points where firefighters could plug in telephone-type transceivers. This system would give NYFD personnel the capability of direct communications between units, thereby freeing manpower currently used for relaying communications. It also would reduce the potential

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for communication errors and delays during emergencies. The Safety Board believes that such a system should be installed to enhance the capability of the NYFD to fight fires and evacuate passengers.

The NYFD officers stated that firefighters often encounter communications difficulties during emergencies because they lack adequate maps of the subway system. In order for NYFD personnel to carry out tactical decisions expeditiously during a subway fire/smoke emergency, it is imperative that data on the physical layout of the affected area of the subway be instantly available. Maps of the subway system that lies within the fire battalion's jurisdiction should be developed and distributed to each NYFD battalion. Such maps should contain: (1) complete track layouts, including spur tracks, (2) vent fans/shafts, (3) emergency exits, (4) water sources, (5) structures, (6) station layouts, and (7) other information as deemed necessary for efficient fire/emergency response. These maps should be correlated with the aboveground street system.

During its special investigation, the Safety Board issued Safety Recommendation R-85-29 on March 28, 1985, recommending that the NYCTA:

> Provide to appropriate NYCTA operating, maintenance, and emergency response personnel and to the New York Fire Department maps which show all emergency exits and correlate subway track locations with street locations.

The NYCTA responded that it is in the process of developing maps correlating track and emergency exit locations with the city street. The Safety Board believes that the lack of maps has been a a very important factor in delays experienced by the NYFD in coordinating the shutdown of power and locating fire/smoke incidents. Therefore, these maps should be developed without delay.

An incident occurred during the special investigation that illustrated another communications problem between the NYCTA and the NYFD. On December 11, 1984, the NYFD received a report from the NYCTA of smoke coming from a train stopped at Varick and King Streets (Houston Station). Firefighters arrived onscene at 12:40 p.m. The fire chief observed smoke coming from under the train and requested that the motorman move the train out of the station. The motorman, with an NYCTA supervisor onboard the train, refused to move the train because he said that it was against NYCTA policy. Approximately 200 passengers were instructed to leave the train and were discharged to the station platform. When the NYCTA supervisor observed that the power grids were overheating, he had the operator move the train out of the station, and the fire source was found to be trash burning on the track behind where the train had been standing. No request for power to be removed was made, and the fire was put out by the NYCTA supervisor using a hand-held fire extinguisher. The fire chief expressed concern that the train operator and supervisor had refused to move the train earlier.

Another fire chief told of another incident where the NYFD responded to a trash fire on a station platform. During the attempt to extinguish the fire, a train entered the station and stopped at the platform. When the fire chief attempted to keep the passengers on the train, the train operator and conductor ignored his instructions and opened the doors of the train. The passengers were immediately discharged into the area of the burning trash, exposing them to the fire and smoke.

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The NYFD liaison officer advised that there have been numerous incidents when NYFD personnel at the scene of a fire/smoke incident in the subway system have been unable to locate an NYCTA supervisor at the site of the emergency. This special investigation confirmed that this is a problem the NYCTA needs to resolve. NYFD personnel who respond to an emergency within the subway system should be able to identify an NYCTA supervisor at the site of the emergency for the purpose of coordination. Information regarding trains, tracks, power, etc., usually will be needed immediately by firefighting personnel. This information can be provided only by technically qualified NYCTA personnel who have authority to make on-site decisions.

The Safety Board believes that many of these communications problems discussed above could be eliminated or reduced if the NYCTA track and car personnel and key supervisors were to attend NYFD-conducted training sessions in subjects such as firefighting (small fires), interaction with emergency command posts, and NYFD operations. Some training on fighting small fires already is being conducted by the NYCTA; however, direct involvement in this training by NYFD personnel would provide a better perspective for trainees as well as a better understanding of the NYCTA and NYFD interrelationship during emergencies. Conversely, direct involvement by the NYCTA in the transit system firefighting training programs conducted by the NYFD would improve the firefighters' understanding of NYCTA operations and procedures.

On May 25, 1982, the Safety Board issued Safety Recommendation R-82-42 to the NYCTA:

> Review and revise the procedures for notification of emergency and rescue personnel to eliminate delays and provide as much available information as possible to assist them in assessing the equipment and manpower requirements.

On August 16, 1982, the NYCTA replied that,

> Interagency Standard Operating Procedure (SOP) #1, "Response to NYCTA Emergencies," [implemented on August 25, 1975] has recently been reviewed and revised. The purpose of this SOP is to: (1) emphasize safety concepts during emergencies; (2) establish an interagency command post at the emergency site; (3) describe the operation of the NYCTA Command Center and Control Centers; (4) provide for dependable interagency and intra-agency channels of communication during major emergencies; (5) delineate interagency procedures for specific emergencies, and (6) list NYCTA fire fighting equipment for underriver tunnels.

On June 28, 1983, the NYCTA replied further that,

> The interagency Standard Operating Procedure (SOP) #1, "Response to NYCTA Emergencies," has recently been reviewed and revised. This document is currently in draft form awaiting approval.

On September 26, 1984, the NYCTA stated,

> We fully recognize the importance of coordinating the modification and response activities of TA and outside agency personnel during subway

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> emergencies. In an effort to improve this coordination we have met with the Fire Department a number of times during the past few months to discuss specific problems related to emergency situations. These meetings have proven to be an effective means of resolving coordination problems. As a result, we are now in the process of establishing an inter-agency committee consisting of representatives from the Fire Department, Police Department, Emergency Medical Service, and the Transit Authority. This committee will meet on a regular basis to address coordination and emergency response problems involving outside agencies. One of the initial priorities of the committee is to review and finalize Standard Operating Procedure #1-"Response to NYCTA Emergencies." We are now in the process of completing our own internal review of the document. Once we have made the necessary revisions, we will submit it to the committee for their review, we expect to have the document formally approved in early 1985.

As of the date of this report, the NYCTA has not issued a revised Standard Operating Procedure #1. The difficulties in communications, emergency planning, and coordination discussed in this report strongly suggest that after 10 years, SOP #1 needs to be revised thoroughly in coordination with all involved agencies, and reissued as expeditiously as possible.

Subsequent to the Safety Board's special investigation, the mayor of New York City requested a joint report from the NYCTA and NYFD regarding the fire problems in the subway system. The NYCTA and NYFD joint report acknowledged many of the problems identified in this investigation and described corrective action that would be taken. However, the proposals put forward to the mayor by the NYCTA and the NYFD have yet to be carried out. They must be followed up, and a concerted effort must be made by the NYFD, the NYCTA, and New York City to bring about improvements and a reduction of fire incidents in the subway system.

The NYCTA and NYFD should establish a joint program to (1) identify the precise scope of the communications deficiencies discussed in this report, (2) initiate corrective action and/or improvements as expeditiously as possible, and (3) establish an ongoing hazard identification system that is administered jointly by the NYFD and the NYCTA to monitor progress in correcting existing deficiencies and to detect and address new problems as they surface.

During its special investigation, the Safety Board issued Safety Recommendation R-85-36 on March 28, 1985, recommending that the NYFD:

> Cooperate with the New York City Transit Authority (1) to develop procedures to reduce communications problems between the two agencies caused by differences in terminology, (2) to develop adequate maps of the NYCTA subway system correlated to street locations, (3) to improve procedures for shutting off third-rail power safely, and (4) to implement Safety Recommendations made to the NYCTA by the National Transportation Safety Board as a result of its special investigation of fires on the NYCTA subway system.

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Car Equipment Fires

A major Safety Board concern is the serious nature of fires that occur in the motor control groups and in the braking grids of passenger rail cars on the NYCTA system. The Board discussed this problem in its special investigation report in 1981. However, the number of motor control group fires on NYCTA cars has continued at a high level. (See table 1.) Motor control group fires have caused severe damage to cars and have generated smoke that endangers passengers and NYCTA and NYFD employees. In many incidents, fires have burned through the car floor into the passenger area.

The Safety Board's investigators observed the operators' handling of 14 selected NYCTA trains to determine if train operations had a relationship to the motor control group fires. The trains observed were selected on the basis of equipment fires that had occurred during the month of November 1984. Investigators observed the ammeter readings in one car on each train to develop parameters for amperage used in the propulsion and the dynamic braking of the train. Observations were made from 5 a.m. to 10 p.m. to include both the morning and evening rush hours. The observations revealed no sustained high readings. The lack of high ammeter readings indicated that trains were not operated for sustained periods in the first power position. There was no pattern of operation, as indicated by the ammeter readings, that would have a relationship to the high incidence of onboard car fires.

Safety Board investigators reviewed practices of the NYCTA in car inspection, maintenance, repair, overhaul, parts procurement, inspection, and distribution. An investigator also reviewed the car equipment department training program. In addition, problems in six cars involved in fire incidents/accidents previous to this investigation, but still available for inspection, were reviewed in detail. In general, problems identified as inadequacies in the inspection, repair, overhaul, and parts procurement process were correlated with problems identified in the detailed examinations of these six cars.

For example, in the six cars involved in fires one or more, and in some cases all, of the following faults were noted:

1. degraded and burned out electrical cable,
2. electrical connections with improper torque,
3. improperly adjusted interlocks,
4. improperly installed cable tiedowns and routing,
5. heavy accumulation of dust (electrically conductive steel dust), and
6. aging (loss of resiliency) on motor controller box seals.

Safety Board investigators found that propulsion equipment was not being cleaned sufficiently at the inspection barns. Nonuniform crimping and rerouting of electrical cables was noted in the repair barns. Proper tools, such as torque wrenches, were not available in the repair and overhaul barns. Modifications and changes to the propulsion units were being made without adequate testing and knowledge as to the consequences of the modifications. Detailed procedures and manuals for making overhauls were not available. Make-do parts were commonly used for repairs because of an inadequate inventory of parts. In addition, equipment inspectors and repair personnel did not have or review the computerized histories on a car before the inspection and repair process was initiated.

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A review of the car histories revealed the following deficiencies:

1. inadequate detail for failure mode analysis,

2. too much manual analysis of the information is required for effective failure forecasting,

3. critical information such as loss of power incidents may not appear on the history, and

4. the computerized history is not made available to the equipment inspectors prior to the inspection.

The review of the parts procurement, inspection, and distribution system revealed a number of problems that contributed to the frequent failure/fire incidents. About 70,000 parts are in the inventory system, and inventory and distribution of parts is done manually. Consequently, there are frequent instances of inadequate inventory which forces repair personnel to take used parts off disabled cars and to effect make-do repairs. The parts facilities were not open on the weekends, which led to the need to make emergency repairs without using the proper parts. Furthermore, although some parts were inspected by the NYCTA upon delivery, the NYCTA did not have a formal procedure for inspecting all parts to determine if they met specifications. Supervisors and mechanics advised that they often had to drill new holes and bend parts to make them fit. Use of parts that do not meet specifications can lead to failure of the motor control group and subsequent fires.

The review found that the mechanical engineering group of the Car Equipment Department was not involved in resolving the electrical/mechanical problems that have plagued the system and lead to frequent electrical/fire problems, and in fact had little knowledge of the ongoing problems. The group was engaged solely in the design of and preparation of specifications for new car procurement.

In a letter of September 18, 1984, to the Safety Board, the NYCTA stated that it had experienced a marked increase in the number of serious fires involving motor control groups in June and July 1984. The NYCTA stated that its most recent examination of the problem indicated that the majority of cars involved in these fires had a history of motor control group problems. The NYCTA explained that its Car Equipment Department had implemented a corrective action plan aimed at reducing the potential for undercar electrical fires. This plan was to use the car equipment information system to identify those cars that had two or more motor control group failures within the past 2 months; to remove from service those cars identified as having three or more failures; and to conduct in-depth inspection, repair, and testing of cars removed from service.

The car involved in a fire at Borough Hall Station on October 11, 1984, had been reported as having motor control group problems seven times in the 4 months before the car burned. During this 4-month period, the car was not taken out of service in accordance with the NYCTA repeat failure program, even though the car case history recorded each of the motor control group problems and failures that the car had experienced. Although on both days immediately before the day of the fire the car had been reported as "dead," 8/ the car still was not identified as having repeated problems. In addition, when the car was tested in September 1984, the car experienced numerous sequence problems.

8/ "Dead" means motor not functioning due to an electrical problem.

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The motor control group located under the floor at the center of the railcar contains electrical control devices for car operation. In response to the activation of controls in the operating compartment of the car, the devices within the motor control group in turn activate electrical circuits to control the power, braking, coasting, and reversing functions of the train. When a rail rapid transit train is assembled for daily service, the controller in the operating compartment of the lead car is selected as the "master controller" to run the train, and the controllers in the other cars in the train are placed in the off, or inoperative, position. The motor control group of each car applies power to each car according to the functions selected by the master controller, and relays signals from car to car in series. Only the master controller selects the circuits to control the operation of the train.

Several types of motor control groups are used on NYCTA subway cars built since January 1968, but only the two different types manufactured by General Electric and Westinghouse were used on NYCTA cars from the R-12 car introduced into service in July 1948 to the R-40 car placed in service in January 1968.

While the General Electric and Westinghouse motor control groups are similar, they use different methods to select the circuits for the various train functions. The General Electric motor control group selects the circuits electrically; the Westinghouse motor control group uses an air-operated cam to select circuits and thus requires air lines to the motor control group to operate the cam. This supply of air becomes a source of oxygen which increases the intensity of a fire when the air lines in the motor control group are burned through.

The NYCTA recognizes the serious nature of a motor control group fire and has classified the hazard severity as catastrophic. Several other transit agencies also have experienced fires in motor control groups, and following the Safety Board's special investigation report in 1981 of the NYCTA system, the American Public Transit Association (APTA) established a task force to study the problem. APTA later issued its "Report of the Propulsion Control Group Fires Task Force," and at a meeting on January 5 and 6, 1983, several transit systems discussed their programs for improved performance. The report describes the Port Authority Trans-Hudson (PATH) System's proposed modifications to the Westinghouse cam pneumatic control and to surrounding cables and air lines. They include installation of a Westinghouse air velocity fuse, use of stainless steel hoses, and installation of additional heat shielding between 600-volt d.c. cables and the car floor. PATH also was considering changes in its similar motor control groups for new car specifications to include relocation of air lines to prevent brake line discharge. PATH subsequently made these modifications to its cars, and the number of fire incidents in motor control groups has been reduced.

The Washington Metropolitan Area Transit Authority (WMATA) reported that it has provided protection on its cars that includes brakes and power overload. In this modification the line breaker is set to trip three times and then lock out. The WMATA reported that 55 to 60 failures had occurred on its system due to operating cars pulling disabled cars in the dynamic brake mode. The WMATA reported on the testing of temperature sensors in the motor control group and presented a WMATA engineering report, "Propulsion System Grid and Cable Temperature Measurements," of December 7, 1982, which stated, in part:

> From review of the documented data and previous experience obtained through temporary installation of Temperature Control Devices, it is recommmended that four (4) Temperature Control Devices be installed.

> Three (3) devices E105-8BS (temperature range 350 degrees to 640 degrees F) be installed over the grids, one (1) device over power grids and two (2) devices over dyanamic brake grids. One (1) device E105-3BS (temperature range 100 degrees to 400 degrees F) be installed within the cabling area.
>
> All devices to be connected in parallel to ensure that any device activation will de-energize or cancel current flowing within a circuit.

Subsequent to the APTA report, the WMATA installed the temperature control devices on its car equipment and has not experienced a major motor control group fire on any car in the fleet.

As as result of its 1980-1981 special investigation, the Safety Board issued Safety Recommendations R-81-113 and -114 on December 30, 1981, recommending that the NYCTA:

> R-81-113
>
> Relocate the main airbrake line of subway cars away from the motor control group to reduce the possibility of rupture in the event of a motor control group fire.
>
> R-81-114
>
> In subway cars having an air-activated motor control group cam, modify the air lines to provide a means of preventing the unrestricted flow of air in the event they are ruptured.

The NYCTA responded that its Car Equipment Department would begin implementing Safety Recommendation R-81-113 with the R-29 car overhaul project which began in July 1985 with four cars completed in August 1985. The NYCTA plan is for the completion of 4 cars each week for a total of 82 cars by the end of 1985 and the remaining 154 cars in 1986. Relocation of the main airbrake line will be included in the specifications of all subsequent overhaul projects.

Regarding Safety Recommendation R-81-114, a spokesman for the NYCTA at the APTA Task Force meeting on January 5 and 6, 1983, stated that the short history of air velocity fuses (AVFs) has indicated that they reduce both the quantity and extent of motor control group fires. The NYCTA plans to add more AVFs to existing cars. AVFs had been installed on 1,689 NYCTA cars as of August 1985. All pneumatic cam-operated controllers are to be equipped with the AVF. Some filter-plugging problems were noted in the AVF installations. These problems have been corrected. The NYCTA has ordered the installation of the AVFs on all cars equipped with Westinghouse air-activated controllers, from the R-17 to the R-44 car class.

The installation of AVFs in the motor control groups should reduce the severity of motor control group fires. Relocating the main airbrake lines away from the motor control group is more likely to protect the integrity of the lines in the event of a fire in the motor control group and allow the operator to restore air pressure so as to be able to move the train to the next station to discharge the passengers. Each of these modifications will make controlling the fire more certain and make for quicker and safer discharge of passengers at a station platform in lieu of the subway trackway when a fire in the motor control group occurs.

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However, these fixes will not eliminate the motor control group fires. For example, temperature control devices have resulted in eliminating major motor control group fires in the WMATA system. The NYCTA has stated that it believes its problems differ from those in the WMATA system in that its fires originate from electrical arcing and not overheating as they did on WMATA cars. The Safety Board believes that the NYCTA should not rule out the possibility that many of the motor control group fires on its equipment may be due to overheating, and that temperature control devices should be considered as a possible method to eliminate fires due to overheating within the motor control groups. The NYCTA should conduct tests of the temperatures being generated within the motor control groups in service on the NYCTA.

Safety Board investigators noted in the course of this special investigation that train operators repeatedly activated the reset button on the motor control group. Investigators interviewed a number of train operators and conductors, all of whom had attended the NYCTA training program at which they were taught to reset the motor control group no more than twice without reporting to the NYCTA Command Center. However, the practice of some train operators of not reporting two unsuccessful uses of the motor reset buttons to the command center can increase the potential for a motor control group fire. This can occur since the train operators often are changed at terminals; therefore, successive train operators also could encounter a similar motor shutdown and use the reset button two more times, thus increasing the potential for a fire. Some train operators said that they reported to the command center every time they had problems causing a slow train that required the operation of the reset button on the motor control group. Others said that they only reported to the command center when the operation of the reset button did not correct the problem.

During its special investigation, the Safety Board issued Safety Recommendation R-85-32 on March 28, 1985, recommending that the NYCTA :

> Prohibit the resetting of car motor control units that have shut down three times, and develop procedures which provide relieving train operators information on the number of times the units have been reset.

The NYCTA responded that:

> The Car Equipment Department (CED) believes that implementation of this recommendation would pose a number of problems because of the nature of our operational environment, where non-serious nuisance type incidents would often result in a shut-down of the motor control unit. In effect, a lockout of the reset mechanism after three faults would be too restrictive, and would most likely result in too many "dead" cars in revenue service. We believe that a determination needs to be made regarding the number of repetitive failures that can occur before the propulsion system needs to be locked out. Tests are being conducted to determine an objective and reasonable number of acceptable resets to provide safe protection for the propulsion system, and ensure the safe and effective operation of trains. As part of this test, we have installed four new General Electric (GE) R-62, type (SCM-1) propulsion controllers on some R-26, 28 and 30 cars. These controllers replaced the older GE MCM type equipment. They are equipped with a monitoring device that senses and records propulsion and braking overload failures.

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> The counters on these controllers can be set at various levels from a minimum of five to a maximum of eight. The device counts the number of times the system is reset, and will automatically lockout the propulsion system after a pre-determined number of safety failures.
>
> All future propulsion controllers will be equipped with this type of supervisory control. These "dead car indicators" will include an exterior illumination device on both sides of the car so that the train crew and road maintenance personnel will be able to identify cars with propulsion equipment shut-off.

The NYCTA response to Safety Recommendation R-85-32 regarding prohibiting the resetting of motor control groups does not meet the intent of the recommendation. The new equipment now being tested by the NYCTA is General Electric equipment; no reference to Westinghouse controllers is made, yet the greatest number of motor control group fires occur on cars with the Westinghouse controller. Accordingly, the Safety Board believes that the tests involving General Electric equipment will not produce the data necessary to establish a satisfactory requirement to restrict uncontrolled resetting of the motor control groups. Also, the Board believes that any shutting down of the motor control groups in service indicates a problem. To reset beyond the third automatic shutdown in service involves risks to which the passengers should not be exposed. To continue to reset will aggravate the underlying electrical problem and the short that is likely to ensue could cause overheating or arcing, resulting in a fire. The concern expressed by the Car Equipment Department that a "lockout of the reset mechanism after three faults would be too restrictive, and would most likely result in too many 'dead' cars in revenue service," fails to address the overriding issue of why the motor control groups are having faults that require frequent resetting. Other transit systems are using the lockout of the reset mechanism after the third automatic shutdown and are not experiencing the fires that have been occurring on the NYCTA.

The operation of trains with "dead" cars is an issue that also needs to be addressed by the NYCTA. Dead cars should not be allowed to remain in a train after reaching the end-of-line terminal; dead cars can overload the working motor control groups and cause a fire, as was the case on December 13, 1984, at the 34th Street Station. (See appendix C.) The NYCTA should reconsider its approach to the problem of resetting motors in service.

As a result of its 1980-1981 special investigation, the Safety Board issued Safety Recommendation R-81-105 on December 30, 1981, recommending that the NYCTA:

> Increase maintenance surveillance and enhance quality assurance of subway car inspections.

The 1981 special investigation report discussed a car that had been sent to the repair facility because a defective motor control group had a burned component. The same day the car was released from the repair facility as being repaired, the motor control group again burned and caused a major fire in the car. The car that burned in the accident at Borough Hall Station on October 11, 1984, also was released as being repaired and then burned on the first trip after leaving the repair facility. (See appendix C.) The NYCTA responded to Safety Recommendation R-81-105 that it planned to add 200 additional managers in the Car Equipment Department. They were to be located at all repair

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facilities to increase surveillance of maintenance and inspection activities. The motor control group fire on October 11, 1984, indicates that increased managerial surveillance has not been able to ensure that the work done on the motor control groups is adequate.

In its 1981 special investigation report the Safety Board stated,

> The maintenance program deficiencies disclosed by this investigation included poor performance of inspections and maintenance, inadequate maintenance supervision and surveillance, inadequate quality assurance inspections, insufficient training for car repairmen and quality assurance personnel, the lack of effective systems for identifying and communicating safety-related equipment problems to NYCTA management and directing the car maintenance program to adequately address car maintenace needs. These deficiencies, which violate principles of preventive maintenance, cannot be considered isolated failures. They are indicative of gross inadequacies throughout the car maintenance program. They are all more disturbing in view of the fact that these inadequacies have not suddenly appeared; they had been identified before. Since its reports of investigations of accidents dating back to 1978 the Board has repeatedly found deficiencies in the car equipment department.

Training

The Safety Board investigators reviewed the intensified 12- to 14-week training program planned by the NYCTA for its car maintenance personnel, and discussed in its response to Safety Recommendation R-85-32, to improve the performance of personnel engaged in the installation, inspection, and repair of motor control groups. In this response, the NYCTA stated:

> In an effort to improve the skill of employees working on motor control groups, the NYCTA has established an extensive training program. The former 2-week orientation program did not serve the technical needs of the employee, because the on-the-job training was done by coworkers without a prescribed program or guidelines. The NYCTA reviewed the training program and recognized the shortcomings in the unstructured training that was being given to those employees involved in the inspection and maintenance of motor control groups. The new training program uses educators and on-line supervisors in a school setting. This training includes textbooks that have been prepared by the school staff in cooperation with the manufacturers and computers that take the student through the course and testing material. The NYCTA has estimated that with the present training schedule, it will be 7 years before all employees engaged in this work complete the training.

The Safety Board's review of this training included an examination of the curriculum, the facilities, the training aids, and the testing and evaluation standards and their criteria. The review disclosed that the new training program was well conceived and involved motor control group maintenance and fire prevention, high-quality teaching aids, a well-balanced professional teaching staff comprised of on-line supervisors and educators, an integration of some courses with area vocational-technical schools, and an upgrading of entrance qualifications for new car maintenance personnel.

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The Safety Board is convinced that the NYCTA car maintenance program will benefit from the institution of this training program. The Board believes, however, that all car maintenance personnel should receive this training before the projected 7 years. The Safety Board recognizes that as each group of car personnel completes the 12- to 14-week course, trained people will be entering the shops to begin working on motor control groups. However, because of the large number of people involved in this work, and the numerous deficiencies that exist in the present maintenance program and practices, it may be 2 years before a substantial infusion of trained personnel is made and improvement in the overall system is realized if the planned 7-year program is followed. The Safety Board believes that the NYCTA, without reducing course content, should accelerate the program by adding more classes (perhaps at night) so as to train more employees in a shorter period of time and realize sooner the needed immediate improvement in car maintenance.

The Safety Board has been concerned also about the training of car inspectors in addition to car maintenance personnel, and during its special investigation, the Safety Board issued Safety Recommendation R-85-34 on March 28, 1985, recommending that the NYCTA:

> Increase the number of classes in its training program to improve the performance of employees engaged in the installation, inspection, and repair of group motor control units.

The NYCTA responded that,

> A Preventive Maintenance (PM) training program for Car Equipment Department - Car Inspectors was implemented in February, 1985. A total of 24 Car Inspectors and four Supervisors will be training at all times. Ten training sessions will be scheduled each year and a total of 240 Car Inspectors will receive five weeks of intensive training each year.
>
> Each employee receiving training is tested at the beginning of the session so that his/her entry level skills and knowledge can be determined. Frequent examinations are given throughout the training for the purpose of continually evaluating each individual's classroom learning and practical skills. Their overall skills and knowledge are evaluated at the conclusion of the training through the use of comprehensive written and practical exams.
>
> In addition to this new five-week program for car inspectors, specific five-day courses have also been implemented to improve the performance of car maintenance personnel in propulsion/controller inspection, maintenance and trouble-shooting. They are as follows:

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Propulsion System Related Courses	Personnel Trained Through 2/28/85
R-62 Propulsion	78
MCM Controllers	23
PM Cycle GE Controllers	7
PM Cycle WH Controllers	13
Comprehensive Propulsion	44
Computer Assisted Instruction Propulsion	270
Schematic Reading	136
TOTAL	571

The schedule for the training was developed taking into consideration two basic factors: (1) maximizing the productivity of training personnel and resources, while at the same time ensuring that sufficient time and staff is provided to ensure effective training for existing employees; and (2) the need to retain a sufficient number of car inspectors in the field so that the system-wide car fleet can be maintained. Acceleration of the schedule beyond its current pace would significantly affect our ability to provide safe and dependable service on a daily basis.

The Safety Board has not evaluated the new 5-week and 5-day programs. However, special training for car inspectors is essential and if the curriculums are as well-conceived as the 14-week program, they should be successful.

This special investigation has revealed, however, that many of the car maintenance deficiencies pointed out in the 1981 special investigation report still exist. Until a sufficient number of employees are trained in car maintenance and inspection areas, the Safety Board is concerned that these deficiencies will continue. Consequently, the Board urges NYCTA management to accelerate the training of personnel engaged in the installation, inspection, and repair of motor control groups.

Safety Oversight

The NYCTA receives funds from the Metropolitan Transportation Authority (MTA), the State of New York, and the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation (DOT). However, until May 1, 1984, when the New York State Public Transportation Safety Board (NYSPTSB) was established, no independent agency within the State had had the specific responsibility to oversee safe operation of the NYCTA system. The serious fire safety problems identified in this special investigation reflect the lack of systematic, independent oversight of NYCTA safety for the years prior to 1984.

The inadequacies in the NYCTA car maintenance program identified more than 7 years ago still have not been corrected, despite the Safety Board's repeated warnings and recommendations. The gross maintenance deficiencies led to a series of four derailments in 1978-1979 caused by inadequate inspection of wheels, followed by a series of four motor control group fires 2 years later, and then a series of derailments involving traction motor mount failures in 1981-1982. No other agency at any level of government followed up to ensure that previously identified safety problems were corrected. During those years there was no safety oversight to determine that the NYCTA effectively resolved these problems before they led to another series of accidents.

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The Safety Board's public hearing in 1980 and evaluation of the effectiveness of rail rapid transit safety nationwide revealed that UMTA exercised largely passive Federal safety oversight which has not been effective. In a recent public hearing, UMTA's Director of the Office of Safety and Security stated that, "We (UMTA) have an oversight role in terms of trying to provide maximum safety, generic safety that can be used by all transit systems. But we don't get involved in the operation, the safety operation of transit systems. That's left to the local transit authorities." UMTA does not conduct safety or accident investigations, even of equipment that has been funded by UMTA capital grants.

The Safety Board has advocated previously that applicants for Federal grants be required to submit a system safety plan as part of the application and that UMTA use the evaluation of that plan as a partial basis for selecting those to be funded. At one time, UMTA developed a reasonably effective system safety assurance program, but UMTA never made its requirement mandatory. Even though UMTA has failed to exercise safety oversight, the Board still believes that UMTA has safety oversight responsibilities and should act to exercise those responsibilities.

The Safety Board had identified the need for improved oversight of rail rapid transit safety as early as 1974. At a public hearing held by a New York State select legislative committee on transportation in New York City on October 2, 1974, a representative of the Board spoke in support of the creation of an agency to investigate accidents occurring on public transportation systems in the State. In 1980, following the Board's public hearing in its evaluation of the effectiveness of rail rapid transit safety nationwide, the New York State legislature passed a bill to establish a board for accident investigations in the State. The governor vetoed the bill early in 1981. However, 53 days following the governor's veto, and following the Board's special investigation of the NYCTA in 1980-1981, the Board issued Safety Recommendation R-81-116 on December 30, 1981, recommending that the State of New York:

> Initiate the legislative and/or executive action to authorize a new or existing independent agency to properly oversee and regulate the safety of the New York City Transit Authority.

In response to this recommendation, the New York State legislature in its 1983-84 session passed and forwarded to the governor a bill to establish a board to investigate accidents occurring on public transportation systems and requiring that any municipality operating such a system submit public transportation safety plans to the State Commissioner of Transportation. The governor signed this bill into law. The New York State Public Transportation Safety Board (NYSPTSB) came into being on May 1, 1984.

The NYSPTSB participated as a party in this special investigation, and during the investigation the Safety Board issued Safety Recommendation R-85-35 on March 28, 1985, recommending that the NYSPTSB:

> In consultation with the New York City Transit Authority, establish an action plan for the implementation of Safety Recommendations made to the New York City Transit Authority by the National Transportation Safety Board as a result of its special investigation of fires on the NYCTA subway system. Advise the National Transportation Safety Board of the timetable for the implementation of the recommendations, and furnish progress reports of the implementation.

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On June 3, 1985, the NYSPTSB responded that it was contacting the NYCTA to establish an action plan for implementation of Safety Recommendations R-85-25 through -34 made to the NYCTA on March 28, 1985. As the Safety Board stated in its August 21, 1985, letter to the NYCTA, the Board's preliminary review of the NYCTA's May 16, 1985, response to the recommendations indicated that the NYCTA's actions were not sufficiently comprehensive to satisfy the intent of the recommendations and that the action plan for implementation addressed in Safety Recommendation R-85-35 to the NYSPTSB is needed. The Safety Board appreciates NYCTA efforts to respond to its safety recommendations. Nevertheless, the Safety Board urges the NYCTA to develop an action plan regarding implementation of Safety Recommendations R-85-25 through -34 in consultation with the NYSPTSB. The Safety Board believes that rail rapid transit safety is primarily a local responsibility that is best handled by the State and local decisionmakers who are accountable for the safe, effective, and efficient operation of the rail rapid transit systems. The Safety Board is pleased to see the emergence of the NYSPTSB as a State agency charged with the responsibility for overseeing the safety of local public transportation.

RECOMMENDATIONS

On March 28, 1985, in the course of this special investigation, the National Transportation Safety Board reiterated Safety Recommendation R-81-109 made to the NYCTA on December 30, 1981, and issued the following Safety Recommendations:

--to the New York City Transit Authority:

Immediately conduct a one-time cleanup of the subway tunnels of all combustible materials and debris, augmenting NYCTA resources if necessary, and thereafter schedule a systematic debris collection program and require that collected trash be removed quickly. (R-85-25)

Immediately remove all flammable materials from the subway tunnels, and prohibit the storing of flammable materials in all tunnels. (R-85-26)

Provide fire extinguishers at all designated locations in the subway system, and establish a program to inspect regularly and replace promptly any missing or empty extinguishers. (R-85-27)

Immediately train its command center personnel in the terminology used by the New York Fire Department to facilitate better communications during an emergency, and provide the fire department training materials for its use in familiarizing its personnel with essential terminology used in train operations. (R-85-28)

Provide to appropriate NYCTA operating, maintenance, and emergency response personnel and to the New York Fire Department maps which show all emergency exits and correlate subway track locations with street locations. (R-85-29)

Immediately establish a safe procedure for the New York Fire Department to use in an emergency to remove the third-rail power on the subway system, and disseminate the procedure to all affected parties. (R-85-30)

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Immediately develop procedures for notifying its command center and the New York Fire Department when an emergency exit is unusable and for returning the exit to service as soon as possible. (R-85-31)

Prohibit the resetting of car motor control units that have shut down three times, and develop procedures which provide relieving train operators information on the number of times the units have been reset. (R-85-32)

During the current construction work at the 181st Street Station, install a New York Fire Department-approved standpipe system with connections at the platform level. (R-85-33)

Increase the number of classes in its training program to improve the performance of employees engaged in the installation, inspection, and repair of group motor control units. (R-85-34)

--to the New York State Public Transportation Safety Board:

In consultation with the New York City Transit Authority, establish an action plan for the implementation of Safety Recommendations made to the New York City Transit Authority by the National Transportation Safety Board as a result of its special investigation of fires on the NYCTA subway system. Advise the National Transportation Safety Board of the timetable for the implementation of the recommendations, and furnish progress reports of the implementation. (R-85-35)

--to the New York Fire Department:

Cooperate with the New York City Transit Authority (1) to develop procedures to reduce communications problems between the two agencies caused by differences in terminology, (2) to develop adequate maps of the NYCTA subway system correlated to street locations, (3) to improve procedures for shutting off third-rail power safely, and (4) to implement Safety Recommendations made to the NYCTA by the National Transportation Safety Board as a result of its special investigation of fires on the NYCTA subway system. (R-85-36)

As a result of its complete special investigation, the National Transportation Safety Board recommended that the New York State Public Transportation Safety Board:

Require the New York City Transit Authority to establish integrated reporting systems on track and structures fires and car equipment fires to provide its senior management accurate and complete data for system safety assessments and corrective action plans. (Class II, Priority Action) (R-85-113)

Require the New York City Transit Authority to initiate an internal review process to ensure that all track and structures fires and all repairs and maintenance of car equipment are being reported for entry into its data collection systems. (Class II, Priority Action) (R-85-114)

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Require the New York City Transit Authority to install a hardwire communications system throughout its subway tunnels for use by the New York Fire Department and other emergency personnel. (Class II, Priority Action) (R-85-115)

Require the New York City Transit Authority to establish procedures that prohibit the extended operation of subway trains that have insufficiently powered motor control groups to avoid overloading the working motor control groups. (Class II, Priority Action) (R-85-116)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G. H. PATRICK BURSLEY
Member

October 23, 1985

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APPENDIXES

APPENDIX A

OTHER SAFETY RECOMMENDATIONS ISSUED TO THE NEW YORK CITY TRANSIT AUTHORITY

Establish a systemwide program of initial and recurrent training for car repairmen, car inspectors, maintenance foremen, and quality assurance personnel. (R-81-103) (Closed—Acceptable Action)

Reduce the current 10,000-mile interval between major subway car inspections to provide for more frequent scheduled car maintenance. (R-81-104) (Open--Acceptable Action)

Increase maintenance surveillance and enhance quality assurance of subway car inspections. (R-81-105) (Open--Acceptable Action)

In conducting "hands on" training of employees for responding to emergencies, assign top priority to the training of motormen and conductors. (R-81-106) (Open--Acceptable Action)

Provide training to motormen and conductors to enable them to evaluate emergencies, communicate vital information immediately to appropriate authorities, and ascertain when conditions require the immediate evacuation of passengers. (R-81-107) (Closed—Acceptable Action)

Provide at conspicuous places in all NYCTA subway cars instructions for passengers on what to do in the event of an emergency, including how to escape from burning cars, the location of emergency telephones, ladders and fire extinguishers, and how to exit safely from a tunnel under fire and/or smoke conditions. (R-81-108) (Open--Unacceptable Action)

Provide at least two fire extinguishers, one at each motorman and conductor position, in all subway trains. (R-81-109) (Open--Unacceptable Action)

Prohibit the introduction of untried or untested equipment into passenger service. (R-81-110) (Closed—Acceptable Action)

Clarify to Command Center personnel the importance of notifying the fire department immediately when a fire is detected or suspected. (R-81-111) (Closed—Acceptable Action)

Revise NYCTA emergency procedures to prevent the dispatch or operation of a train with revenue passengers aboard into an area where there is an emergency involving fire and smoke. (R-81-112) (Open--Acceptable Action)

Relocate the main airbrake line of subway cars away from the motor control group to reduce the possibility of rupture in the event of a motor control group fire. (R-81-113) (Open--Acceptable Action)

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In subway cars having an air-activated motor control group cam, modify the air lines to provide a means of preventing the unrestricted flow of air in the event they are ruptured. (R-81-114) (Closed--Acceptable Action)

Revise the NYCTA automated management information system to provide sufficient detailed information to permit analysis of the incidence and causes of failures or malfunctions of equipment which may affect the safety of passengers. (R-81-115) (Open--Acceptable Action)

Review and revise the procedures for notification of emergency and rescue personnel to eliminate delays and provide as much available information as possible to assist them in assessing the equipment and manpower requirements. (R-82-42) (Open--Acceptable Action)

Modify the maintenance and inspection practices in all New York City Transit Authority shops to provide improved quality control of work accomplished during car maintenance. (R-82-50) (Open-Acceptable Action)

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APPENDIX B

SPECIAL INVESTIGATION

The National Transportation Safety Board conducted the field phase of this special investigation in New York, New York, from December 11 through December 16, 1984.

On December 10, 1984, an organizational meeting was held. Groups were formed to investigate track and stations, electrical third-rail equipment, car equipment, train operations, emergency response activities and data collection, and the relationship of each of these factors to fire safety on the subway system.

The groups were composed of personnel from the National Transportation Safety Board, the New York City Transit Authority, the New York Fire Department, the New York Emergency Medical Services, the Transport Workers Union, and the New York State Public Transportation Safety Board. The Urban Mass Transportation Administration assigned an observer to the special investigation.

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APPENDIX C

SUMMARIES OF NATIONAL TRANSPORTATION SAFETY BOARD INVESTIGATIONS OF SEVEN NEW YORK CITY TRANSIT AUTHORITY FIRES IN 1984

	Location	Date	Injuries	Type of fire
1.	Brooklyn Bridge Station	4/6/84	39	Power cable
2.	Rockaway Boulevard Station	4/17/84	1	Car seat
3.	North of 96th Street Station	6/10/84	23	Motor control
4.	59th Street Storage Track	7/3/84	24	Motor control
5.	High Street Station	10/4/84	55	Trash
6.	Borough Hall Station	10/11/84	0	Motor control
7.	34th Street Station	12/13/84	0	Traction motor

1. Location: Brooklyn Bridge Station, New York (Manhattan), New York
Date: April 6, 1984

At 9:50 a.m., on April 6, 1984, the train operator of a New York City Transit Authority (NYCTA) subway train that arrived in the Brooklyn Bridge Station reported by telephone to the operator's office that he had seen an electrical arc and heard a loud noise in the tunnel north of the Brooklyn Bridge Station. An assistant train dispatcher, on duty at the Brooklyn Bridge Station, also heard the loud nose and immediately activated an emergency alarm box and removed the third-rail power from track Nos. 1, 2, 3, and 4 from an area north and south of the Brooklyn Bridge Station extending from Broome Street south to Battery Park in Manhattan. A local and an express train which were in the power outage area came to a stop about 50 feet and 250 feet, respectively, north of the platform of the Brooklyn Bridge Station. Dense smoke began to fill the tunnel and the station.

The passengers on the train that was standing in the station and whose operator had reported the arcing were discharged to the station platform and directed to the street outside of the station. The NYCTA employees working in the station also had to leave the station because of the smoke. The passengers onboard the local train were evacuated through the lead car to the track level, walked to the station platform, and exited to the street level. NYCTA supervisory personnel who entered the tunnel found the smoke to be too dense to be penetrated by flashlights, and they had to feel their way along the side of the cars in the local train. They were met by an unidentified conductor who advised then that the local train had been evacuated. When the NYCTA personnel reached the cars of the express train, however, they found a large number of passengers waiting to be evacuated. Because of the heavy smoke at the head end of the express train, the train operator had moved the passengers to the rear cars. Planks were laid between adjoining cars of the express train and the local train allowing passengers to be evacuated through the local train to a bench wall and then to the street via an emergency exit. The NYFD arrived within 4 minutes of notification and were onscene within 10 minutes after the arcing was first reported. It took 1 hour 11 minutes to evacuate all the passengers from the trains. Two passengers on the express train had heart conditions and needed assistance during the evacuation. Eighteen passengers and 21 NYCTA employees were taken to local hospitals where they were treated for smoke inhalation and released. The arcing and the ensuing fire and smoke were traced to a third-rail power cable. The damage was estimated to be $1,000.

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NYCA emergency procedures require the assistant train dispatcher who becomes aware of an emergency to call the desk train master at the NYCTA Command Center, who then determines the steps to be taken. The primary concern of the desk train master is to move the trains out of the affected area, and to discharge the passengers onto a station platform. The immediate action on the part of the assistant train dispatcher to turn off third-rail power negated this aspect of the emergency plan.

The information given by the conductor to the NYCTA supervisory personnel who arrived on the scene could have been detrimental to a number of passengers remaining in the rear of the southbound express train, if the supervisors had called off their efforts thinking that all passengers had been evacuated from the two trains.

Following the accident, a low spot was found under the track where water had accumulated. The Safety Board determined that the probable cause of the accident was that the pumping action of trains passing over the track splashed water onto the third-rail power cable and saturated the covering and insulation so that the cable shorted out and burned. Contributing to the accident was the inadequately maintained trackway drainage.

2. **Location: Rockaway Boulevard Station, New York (Queens), New York**
Date: April 17, 1984

About 3:25 a.m., on April 17, 1984, a fire started on the next to the last seat of the fifth car of an eight-car, northbound New York City Transit Authority (NYCTA) train after it left the Aqueduct Station. The conductor saw the fire and attempted to notify the train operator by using the public address system microphone in the fourth car and then in the fifth car, but he was unable to communicate with the operator. At the next station, Rockaway Boulevard, the conductor walked to the lead car and notified the operator of the train, who then notified the NYCTA Command Center of the fire. The conductor asked the station porter for a fire extinguisher, because the train was not equipped with one; but because of the smoke and flames neither man was able to get close enough to the fire to use the extinguisher effectively. The passengers were evacuated and the New York Fire Department (NYFD) was notified at 3:54 a.m., 29 minutes after the fire was detected; the first fire unit arrived at 3:57 a.m.

The interior of the car was destroyed. There were no injuries to the passengers or traincrew, but one firefighter was injured. The estimated cost to replace the car was $850,000.

Because the accident occurred at an early morning hour, there were few passengers on the train. However, the NYCTA's 29-minute delay in notifying the NYFD could have been catastrophic if a crowded rush-hour train had been involved, since the fire was out of uncontrol and destroyed the car.

The NYCTA does not carry fire extinguishers onboard trains. Since the conductor was not able to communicate with the train operator to stop the train to obtain a fire extinguisher from a wayside location, he was not able to obtain a fire extinguisher until the train arrived at the next station about 5 minutes later and he was able to obtain one from the station porter.

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When first discovered, the fire was small and could have been extinguished by the conductor with a fire extinguisher if one had been onboard the train. The conductor believed that the fire probably was set by four young persons who were the only occupants of the car before they got off at the Broad Channel Station, two stops before the Aqueduct Station.

The Safety Board determined the probable cause of the accident was a fire that was set intentionally by vandals.

3. Location: North of 96th Street Station, New York (Manhattan), New York
Date: June 10, 1984

Shortly after 1:19 p.m., on June 10, 1984, the train brakes on a 7th Avenue express, a 10-car northbound New York City Transit Authority (NYCTA) subway train applied in emergency moments after the train left the 96th Street Station. The train operator notified the NYCTA Command Center by radio that an explosion had occurred and that smoke was coming from under the train. The command center immediately arranged to remove the third-rail power from track No. 3 in an extended area from 96th Street to 110th Street. The train operator located fire coming from under the fourth car in the train and reported it to the command center. The New York Fire Department (NYFD) was notified, and firefighters arrived onscene within 14 minutes, which included a delay while the NYCTA was making arrangements to remove third-rail power. Because of the dense smoke, the train operator was unable to give the exact location of the train. Consequently, the NYFD was told to report to the 110th Street Station. Passengers were discharged from a train in the station to allow firefighters to board, and the train was operated south toward the 96th Street Station. When the rescue train reached the location where the third-rail power had been removed, an officer of the NYCTA and the firefighters got off the rescue train and began to work their way toward the disabled train, which was very difficult because of the dense smoke. In addition to the disabled train with about 80 passengers, another train with approximately 100 passengers stalled in the tunnel near 103rd Street when the third-rail power was removed. An NYCTA road car inspector and an assistant general superintendent reached the stalled train and began to evacuate the passengers from the train to an emergency exit at 103rd Street and Broadway. Rescue personnel reached the disabled train 1 hour after the fire started and began to evacuate the passengers. All passengers had been evacuated from the two trains by 2:24 p.m., 1 hour 4 minutes after the fire started. Eleven passengers and 12 NYCTA employees were taken to local hospitals, treated for smoke inhalation, and released. The car was destroyed by the fire. Estimated damage was about $800,000.

The NYCTA emergency response procedures were put into effect shortly after the NYCTA Command Center was notified by the operator of the train that his train had experienced a problem. Since the dense smoke prevented the operator of the express train from giving the command center the exact location of his train, this lack of information delayed for 1 hour evacuation of the passengers to a nearby emergency exit and delayed the arrival of NYFD personnel to the burning cars.

The radio in the operating cab of the train that stalled behind the disabled train was found not to be working. The NYCTA log of the event shows that this train operator never was in communication with the NYCTA Command Center, and that the train's presence near an emergency exit was not detected and reported by a road car inspector until 40 minutes after the train stalled.

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Evacuation of the passengers aboard the train stalled at 103rd Street did not begin for 45 minutes. The tunnel was reported to be filled with heavy smoke 21 minutes after the explosion.

The disabled train consisted of a mixed consist of R-14-, R-22-, R-26-, and R-36-type subway cars. Car number 7430, which caught on fire and was heavily damaged, was an R-22-type car built in 1957-58 by the St. Louis Car Company at a cost of $106,699. It contained a motor control group manufactured by the Westinghouse Electric Company.

The intense fire began in the motor control group, burned through the ply metal flooring, and damaged the steel underframe structural members, train line wire, and cables, while destroying the motor control group assembly. The intensity of the fire is believed to have been related to the burning through of the air lines in the motor control group which increased the flow of oxygen to the fire.

The Safety Board determined that the probable cause of the accident was the failure of the motor control group, which generated high temperatures and subsequent fire. Contributing to the cause of the accident was inadequate car inspection and maintenance.

4. Location: 59th Street Storage Track, New York (Manhattan), New York
Date: July 3, 1984

At 8:58 a.m., on July 3, 1984, the conductor of a 10-car northbound New York City Transit Authority (NYCTA) subway train observed smoke coming from under the third or fourth car while the train was at 14th Street. The conductor notified the train operator who advised the NYCTA Command Center. The command center advised him to discharge the passengers and to proceed empty to Grand Central Station where a road car inspector would inspect the train. At Grand Central Station, the road car inspector inspected the train and advised the command center that the New York Fire Department (NYFD) was not needed. The command center gave instructions to place the train on the 59th Street storage track which was accomplished at 9:14 a.m. At 9:38 a.m., while the train was on the storage track, someone noticed that the smoke had increased and that the motor control group was on fire. A line supervisor attempted to pull the knife switch at the 59th Street storage track to remove third-rail power but received an electric shock and was unable to open the switch. The power supervisor at the command center then removed the third-rail power from track Nos. 1A and 4 between 52nd Street and 78th Street. The NYFD was notified of the fire at 9:46 a.m., 48 minutes after smoke first was detected.

The road car inspector and line supervisor unsuccessfully attempted to put out the fire with fire extinguishers obtained from a nearby emergency vehicle and the 59th Street Station token booth. They also obtained additional fire extinguishers at the emergency telephone, at the third-rail lever location, and at the station southbound platform, but all the extinguishers were empty. Two road car inspectors at the scene were overcome by smoke, and an ambulance was used to transport them to a local hospital. While fighting the fire, a trainmaster relayed a request from the NYFD to the NYCTA Command Center that third-rail power be removed on all tracks in the area; however, 12 minutes after the request was made, the fire chief said that it was not necessary to remove power from track Nos. 2 and 3. Again, 7 minutes later the NYFD fire dispatcher requested that the third-rail power be shut off on all tracks. He was

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advised by the NYCTA Command Center that the fire chief did not need the power off on track Nos. 2 and 3. However, 12 minutes later it was reported that a firefighter was missing and power was then shut off on track Nos. 2 and 3. Several minutes later, the firefighter was found, and power was restored to track Nos. 2 and 3. At 11:28 a.m., the fire was extinguished and the NYFD left the scene. The car was destroyed as a result of the fire, and 24 persons were taken to local hospitals, treated for smoke inhalation, and released. The estimated cost to replace the car was $850,000.

The Safety Board determined that the probable cause of the accident was a failure in the motor control group, which generated high temperatures and subsequent fire. Contributing to the cause of the accident was an incomplete car inspection by the road car inspector and inadequate car inspection and maintenance by car maintenance personnel.

5. Location: High Street Station, New York (Brooklyn), New York
Date: October 4, 1984

At 12:16 p.m., on October 4, 1984, a New York City Transit Authority (NYCTA) train operator reported smoke in the tunnel south of High Street Station. He advised the NYCTA Command Center that the smoke was not heavy and that he did not know the source of the smoke. The desk trainmaster issued instructions that the tunnel exhaust fans be turned on in the area for 15 minutes. Maintenance control also received a report of the smoke condition and issued instructions to the track and signal departments to take appropriate action. Track maintenance forces who were dispatched to the area were not successful in determining the cause of the smoke.

Approximately 1 hour later, another train operator reported smoke in the tunnel south of the High Street Station. Again, the desk trainmaster issued instructions to have the exhaust fans turned on, this time for 20 minutes. The desk trainmaster contacted the trainmaster at the Jay Street Station to inquire if there was smoke in the area; the trainmaster reported that no smoke was present at that location.

About 10 minutes later, the operator of a northbound train reported that his train had "brakes in emergency" 1/ just south of the High Street Station and that there was heavy smoke in the tunnel. While the crew was looking for the conductor's emergency valve to determine if it had activated, the last two cars of the train were directly adjacent to a wayside fire and were exposed to heavy smoke conditions. Passengers began to break out the door and side windows of the two cars. With help from an off-duty employee and the conductor, the train operator located and reset the conductor's emergency valve which had been activated. The operator was then able to release the train brake and move the train into the High Street Station. Because of the persisting smoke in the car, the passengers were discharged onto the station platform.

Meanwhile, because of the heavy smoke conditions, the NYCTA Command Center notified the New York Fire Department (NYFD) and ordered all northbound A trains and JFK trains to operate via the Rutgers Street tunnel instead of the normal route through the Cranberry Street tunnel. All trains in the High Street Station area also were ordered to turn off the train air conditioning. During this period the operator of an A train

1/ The term used on the NYCTA to indicate that the train brakes applied in emergency without having been activated by the operator.

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leaving the Jay Street Station reported heavy smoke conditions and was instructed to proceed with caution through the area to the High Street Station. The train was rerouted from track No. A4 to track No. B2. As the train proceeded on track No. B2, NYFD personnel who had entered the tunnel via an emergency exit directed the operator to stop the train. By then firefighters had discovered a trash fire on and around a 100-foot-long section of track No. A4, and there was dense smoke in the area. The fire on track No. A4 was directly below track No. B2. Because a chamber in the tunnels connected both track levels, smoke from the fire on the lower-level track No. A4 followed the chamber to the upper-level track No. B2, and the stopped train was engulfed in the dense smoke. Smoke was pulled into the area of the stopped train on track No. B2 because a ventilation fan, located 25 feet from the lead car of the stalled train, was activated in the exhaust mode. After the train was stopped by the NYFD and the third-rail power was removed from the track, the train could not move out of the smoke-filled tunnel. The NYFD evacuated the passengers through an emergency exit about 50 feet to the front of the train to a street level exit. About 50 passengers walked along the bench wall from the rear of the train to the Jay Street Station.

NYCTA Command Center personnel were unaware of the presence of the structural chamber connecting the two track levels that permitted smoke to pass from track No. A4 to track No. B2. The command center personnel who were involved in this accident stated that had they been aware of the physical characteristics of the tunnel at the time of the fire, they would not have allowed the train to leave the Jay Street Station.

Emergency Medical Services (EMS) personnel treated and transported 54 injured persons to seven area hospitals. Most of the injured were treated for smoke inhalation and released. One firefighter was treated at a hospital for a broken ankle. There was no fire damage to the two trains; however, the cost to repair the broken windows and door damage was estimated to be about $10,000.

The Safety Board determined that the probable cause of the accident was the excessive accumulation of trash in the trackway of track No. A4 which was ignited by sparks from passing trains. Contributing to the severity of the accident was a lack of coordination between the NYFD and NYCTA in removing third-rail power.

6. Location: Borough Hall Station, New York (Brooklyn), New York
Date: October 11, 1984

At 5 p.m., on October 11, 1984, a southbound New York City Transit Authority (NYCTA) train arrived at the Borough Hall Station in Brooklyn with smoke issuing from under the eighth car in the train. The passengers were discharged to the station platform without injury, and NYCTA personnel attempted to extinguish a fire in the motor control group. The New York Fire Department (NYFD) was called at 5:02 p.m. and arrived at 5:10 p.m., extinguished the fire, and departed at 6:51 p.m. The car was destroyed. The estimated cost to replace the car was $850,000.

The car was a model R-33 and equipped with a motor control group manufactured by the General Electic Company. On the day before the accident, the car had been found to have burned motor resistor leads and welded switch contacts in the motor control group and had been reported as having had motor control group problems seven times in the preceding 4 months. When the car was tested in September 1984, the car experienced

numerous sequence problems. The car was inspected, repaired, and given a power and sequence test on October 10 before it was returned to service on October 11, 1984. When the fire occurred, the car was on its first trip since being serviced

The Safety Board determined that the probable cause of the accident was the burned motor resistor leads and welded switch contacts on the motor control group, which probably were not repaired properly and caused excessively high temperatures and eventual fire in the motor control group. Contributing to the cause of the accident was the lack of adequate car maintenance and quality control inspection.

7. Location: 34th Street Station, New York (Manhattan), New York
Date: December 13, 1984

At 1:51 p.m., on December 13, 1984, a four-car northbound New York City Transit Authority (NYCTA) train departed the World Trade Center terminal. After departure the train operator reported to the NYCTA Command Center that he had a slow train. The train operator attempted to reset the motors by pressing the reset button twice, but the train did not respond and continued at the slow speed. A road car inspector met the train at the West 4th Street Station and boarded the train.

The inspector began to check the motoring of each car and found by checking the ammeter reading on the first car that it was taking power. However, the second car had a zero ammeter reading, and when he attempted to reset the motors, the car took power briefly and then shut down. The last two cars also had zero ammeter readings; the motors would not reset even briefly. The NYCTA has a practice that a train is not to be dispatched from a terminal unless two-thirds of the cars in the train take power. The 800 passengers onboard were discharged at the station, which the inspector reported to the NYCTA Command Center. The inspector requested that the train be moved to 59th Street and placed on the storage track. The command center authorized the move, and the train proceeded.

The train, while en route to 59th Street, entered the 34th Street Station, where the inspector heard an explosion and saw an electrical arc, fire, and smoke coming from under the lead car in the train. He instructed the operator to stop the train and report the fire to the NYCTA Command Center, which then notified the New York Fire Department (NYFD). The inspector found a fire extinguisher in a token clerk's booth in the station, returned to the train, and descended to the track level on the left side of the train, the side away from the platform. From his position he was able to determine that the fire was in the resistance grids and electrical leads on the right side of the train, the side next to the platform. He attempted to extinguish the fire from his position on the left side of the train but was unable to do so. He then climbed under the train to get closer to the fire, but the fire flared up and he was engulfed in dense smoke. By the time he was able to get near the fire, the fire extinguisher was depleted. He immediately left the scene and walked south along the track to get an additional fire extinguisher at a blue-light station, 2/ but there were no extinguishers at any of the locations he checked. When the train operator and the inspector returned to the train, the NYFD had arrived onscene and had extinguished the fire. The traction motors and motor control group were damaged by the fire. The estimated damage was $100,000.

2/ An emergency alarm box (power removal) location located every 600 feet in a subway tunnel.

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The decision to move the train to 59th Street was questionable. The inspector knew that only one car of the four-car train was powered. Even though the train was empty, it was predictable that with only one powered car in the train that the electrical circuits of the car would be overloaded and quite possibly cause a fire. The attempt to move the train to 59th Street under power led to a fire and to other trains being diverted or held in both directions until the fire was extinguished and the smoke had cleared.

Since the NYCTA does not have fire extinguishers onboard trains, the delay involved in obtaining a fire extinguisher from the station booth and the fact there were no fire extinguishers at the emergency blue-light locations most likely contributed to the progression of the fire and resulted in the destruction of the traction motors and motor control group on the car.

The Safety Board determined that the probable cause of the accident was the movement of the train without an adequate number of operating traction motors which caused the motors to overheat and catch fire. Contributing to the severity of the accident was the lack of fire extinguishers onboard the train and the fact that there were no extinguishers at emergency blue-light locations.

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